Version with markings to show changes made.

Original Drawings

Remarks / Arguments

The first modifications from the original drawings were done in response to the office action of 1-17-01. The modification at that time entailed the resizing of the drawings that were referred to as illegible. The drawings submitted at that time were (still) not in the required format.

Additional modifications have been performed to comply with the office action of 8-13-01. The equations have been removed from the specification and included with the drawings. Each (drawing) entry is properly identified with a "FIG." Preceding the drawing number. All of the drawing entries were modified so that they are clear and legible, and displayed in portrait orientation. All text was removed from the drawings. The drawings are now displayed in the proper format.

In this marked-up original, any material that has been removed (for the clean version) is surrounded with brackets ({}). New/added material that was not in the original is underlined(_). Comments are surrounded by asterisks (*).

DRAWINGS
Graph modified

{

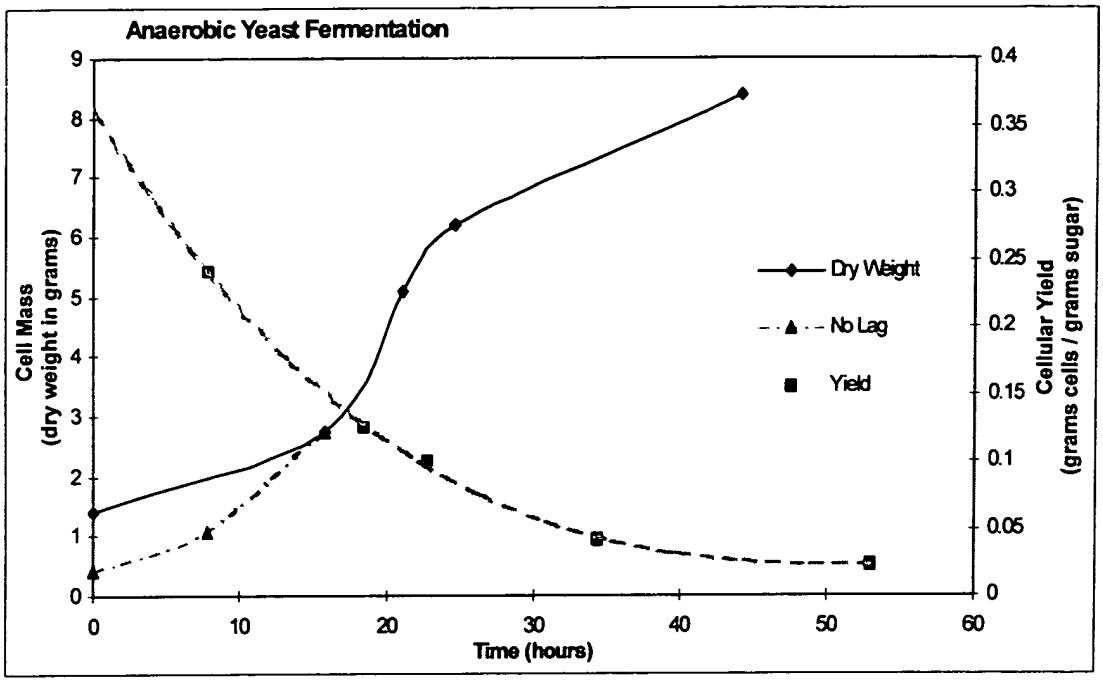


Figure 1

}

revised graph

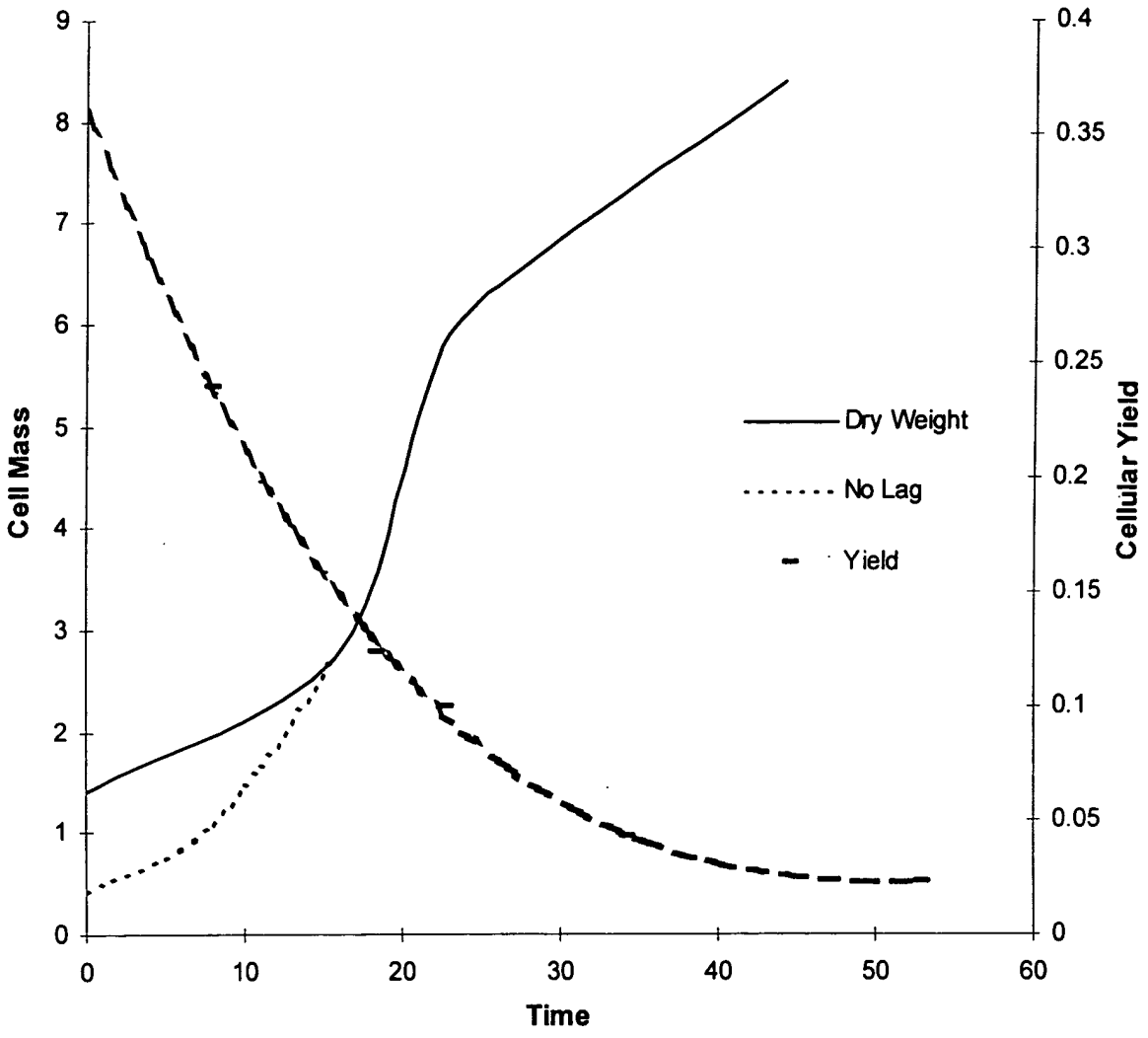
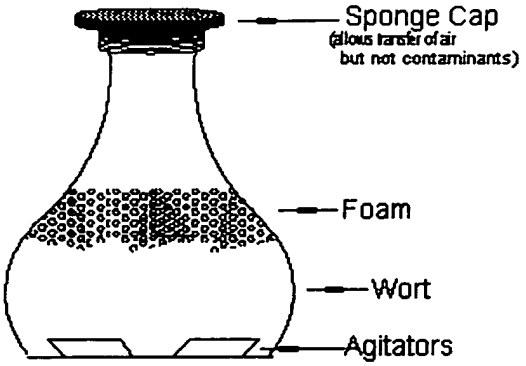


FIG.1

Drawing modified

{



2 liter Fernbach Flask

Oxygen transfer is limited by the small surface area on the top, and the foam that forms.

Figure 2

}

Revised drawing

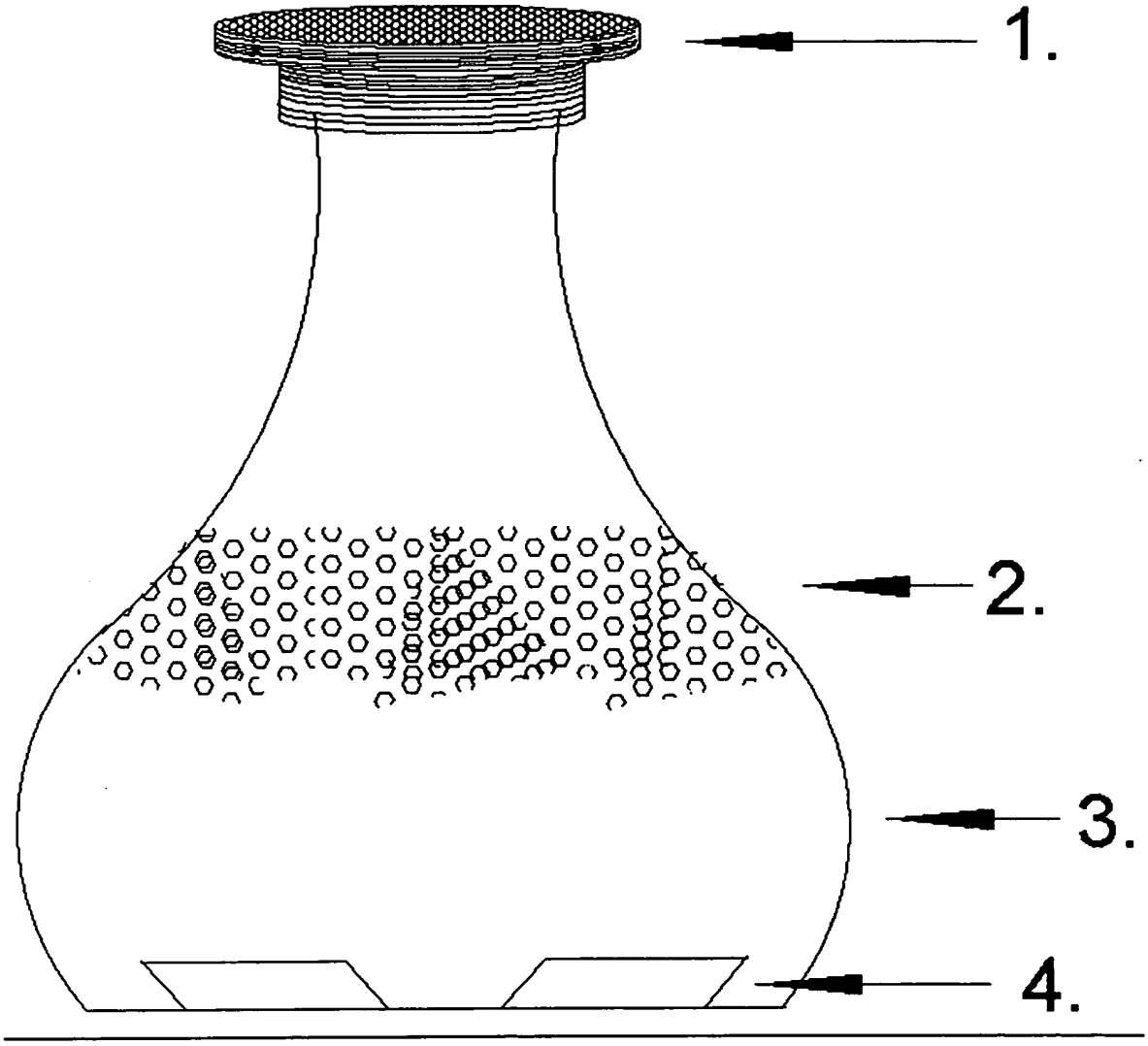


FIG.2

Equation added

$$\begin{bmatrix} 100 \text{ grams sugar} \\ +\,3.75 \text{ grams ammonia} \\ +\,64.95 \text{ grams oxygen} \end{bmatrix} \Rightarrow \begin{bmatrix} 46.88 \text{ grams water} \\ +\,50.93 \text{ liters carbon dioxide} \\ +\,30 \text{ grams yeast} \end{bmatrix}$$

FIG.3

Table modified

{

Time During Fermentation	Yield (g cells/ g sugar)	Ammonia Needed (grams)	Water Produced (grams)	CO_2 Produced (liters)	Yeast Produced ($C_6H_{10}O_3N$) (grams dry wt.)	Ethanol Produced (C_2H_6O) (grams)*
1st 3rd	.15	18.70	5.1	22.51	15.04	41.19
2nd 3rd	.052	.65	1.79	25.54	5.20	47.68
3rd 3rd	.023	.29	.79	26.44	2.30	49.61
Overall	.05	.626	1.72	25.60	5.00	48.52

*** For ethanol volume, divide weight (in grams) by its' density (0.789 grams/ml)**

Table 1

}

Revised table

Time During Fermentation	Yield (g cells/ g sugar)	Ammonia Needed (grams)	Water Produced (grams)	CO_2 Produced (liters)	Yeast Produced ($C_6H_{10}O_3N$) (grams dry wt.)	Ethanol Produced (C_2H_6O) (grams)*
1st 3rd	.15	18.70	5.1	22.51	15.04	41.19
2nd 3rd	.052	.65	1.79	25.54	5.20	47.68
3rd 3rd	.023	.29	.79	26.44	2.30	49.61
Overall	.05	.626	1.72	25.60	5.00	48.52

FIG.4

Equations added

$$CO_2 \text{ solubility (in l } CO_2/\text{l } H_2O) = -1.06556266071 \times \ln(°F) + 5.38424482284$$

FIG.5

$$\frac{\text{Change in yeast mass}}{\text{Change in time}} = \frac{\Delta X}{\Delta t} = \mu \times X$$

$$\ln\left[\frac{X}{X^{\circ}}\right] = \mu \times (t - t_{lag})$$

FIG.6

$$t_d = \frac{\ln (2)}{\mu}$$

FIG.7

$$\text{Ratio}\left[\frac{l\,CO_2}{g\,\text{sugar}}\right] = 0.271599039164 - (0.310674946821 \times \text{Yield})$$

FIG.8

$$\text{Specific Gravity} = (3.652010359\,96 \times 10^{-4}) \times S + 0.999953627005$$

FIG.9

$$Y = \frac{\Delta X}{\Delta S}$$

FIG.10

$$\left[\frac{\Delta X\,(for\ \text{decay})}{\Delta time}\right] = b \times X$$

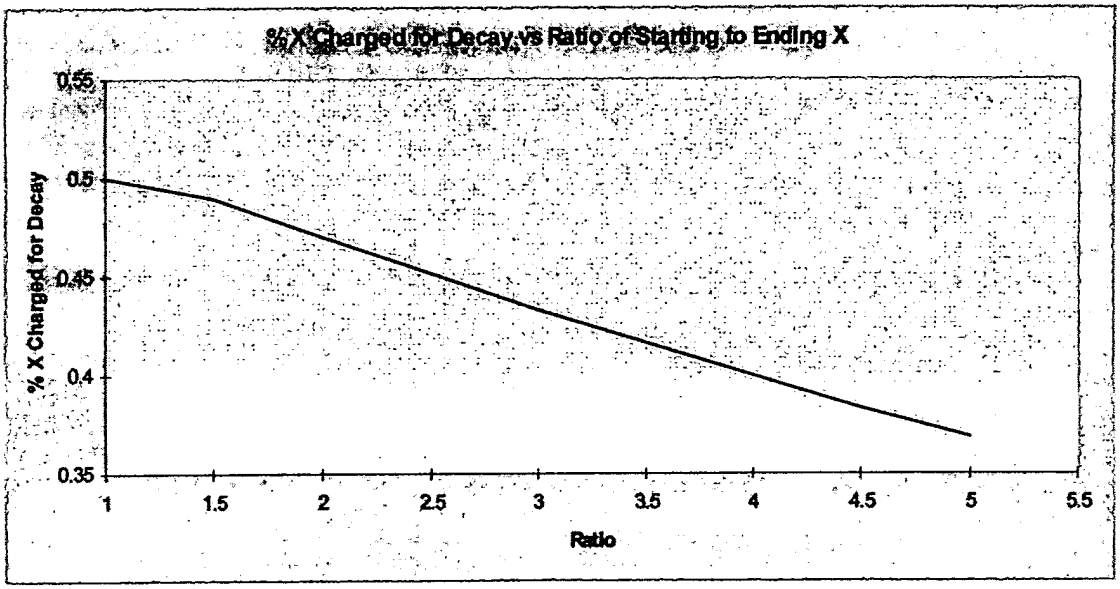
FIG.11

$$Y = \left[\frac{\Delta X}{\Delta S}\right] = \left[\frac{5.14794}{24.644}\right] = 0.20889 \frac{g\,X}{g\,S}$$

FIG.12

Graph modified

{

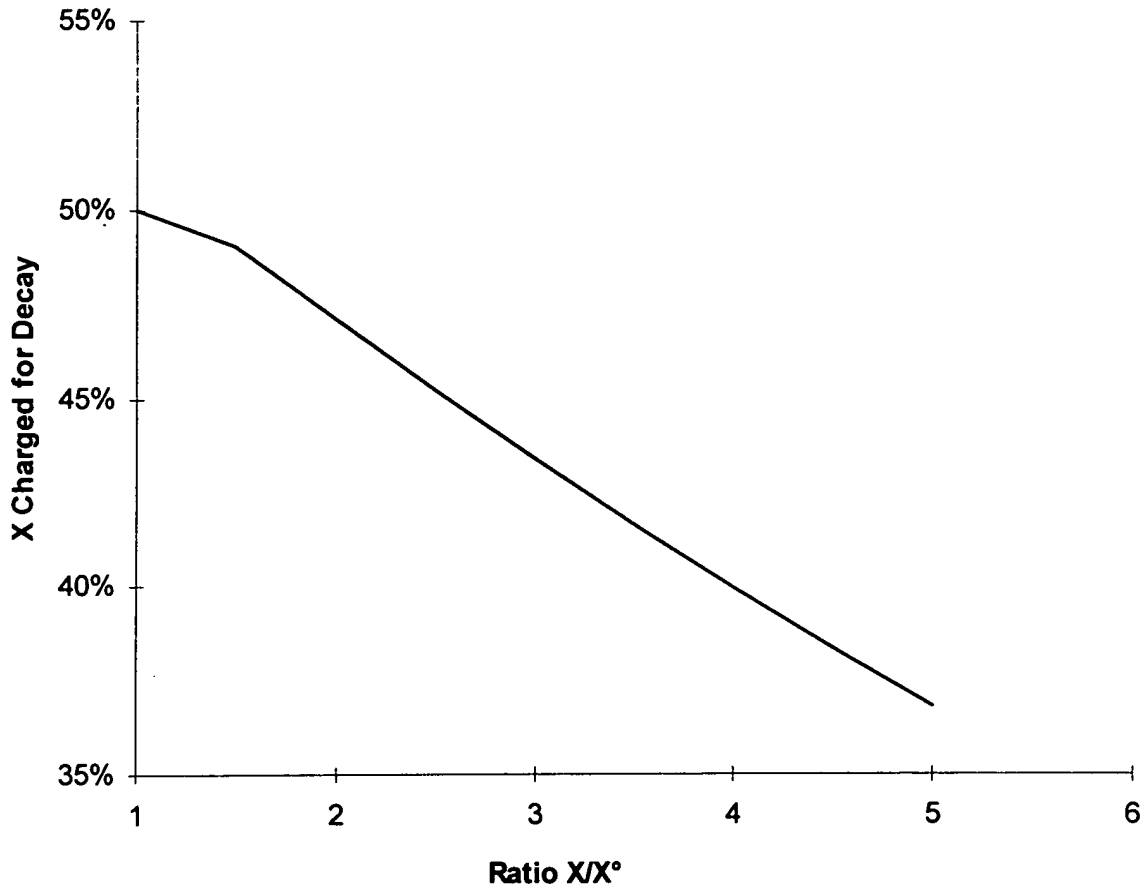


EQXchrgd **Xchrgd = 0.504076447609 × EXP(- 0.0816252748703 × Ratio)**

Figure 3 / Equation 10

}

Revised graph



$$Xchrgd = 0.5040764476609 \times EXP(-0.0816252748703 \times Ratio)$$

FIG.13

Table modified

{

Sample Name	Time (hours)	X weight (grams)	S.G. Reading (g S/l, see EQSG)	Measured CO2 Flow (ml / min)
t_0	0	1.415	183.59	0
t_1	15.75	2.73	178.11	3.944
t_2	21.03	5.1	158.94	12.344
t_3	24.5	6.18	147.99	15.074
t_4	44.08	8.38	95.965	7.234

Table 2

}

7/10

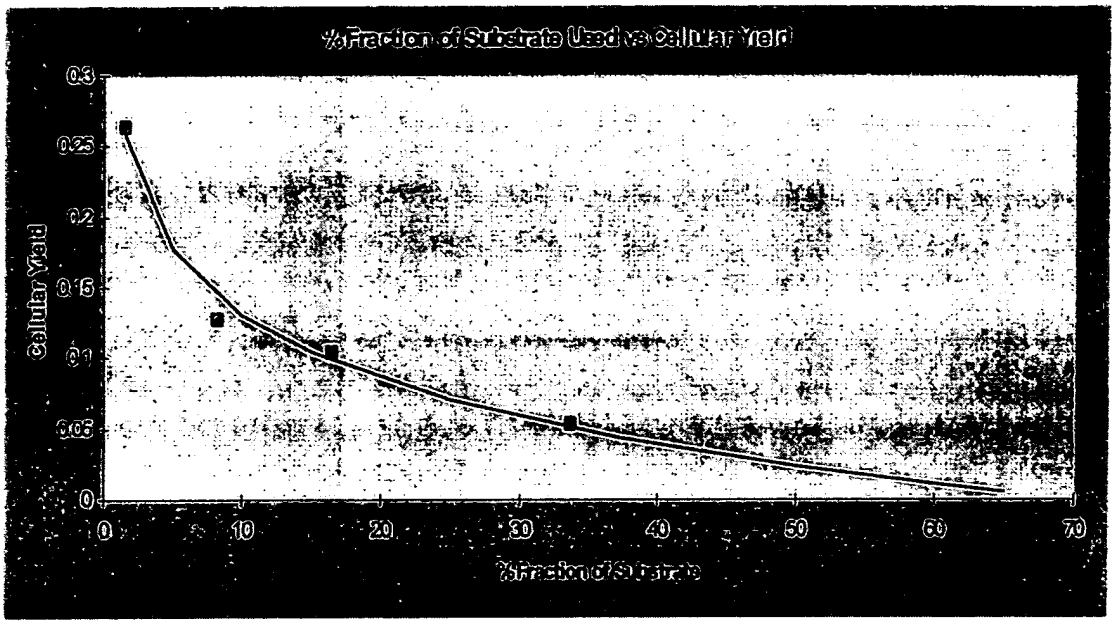
Revised table

Sample Name	Time (hours)	X weight (grams)	S.G. Reading (g S/l, see EQSG)	Measured CO2 Flow (ml / min)
t_0	0	1.415	183.59	0
t_1	15.75	2.73	178.11	3.944
t_2	21.03	5.1	158.94	12.344
t_3	24.5	6.18	147.99	15.074
t_4	44.08	8.38	95.965	7.234

FIG.14

Graph & table modified, and positions switched

{



Comparison of the four data points with the yield curve (EQ%used)
$Y = -6.67814305038 \times 10^{-2} \times [\ln(\%used)] + 0.284841059276$
log fit; r^2 : -.9924

Figure 4

}

Table changed to portrait orientation

{

b=.004/hr

Test Fermentation Data

A Interval	B Observed New X	C Total hours of interval	D Mass lost from starting X decay	E Sub-total new mass (B + D)	F Ratio new X/Start X (Starting X + E) / Starting X	G Charge what new mass b? (EQXchrgd)
$t_0 - t_1$	1.315	15.75	0.089145	1.404145	1.9923	0.471
$t_1 - t_2$	2.37	5.28	0.0576576	2.4276576	1.88925	0.475
$t_2 - t_3$	1.08	3.2	0.06528	1.14528	1.22457	0.5
$t_3 - t_4$	2.2	19.58	0.4840176	2.6840176	1.434307	0.493

A Interval	H Decay of new mass (E x G x C x .004)	I Total new mass yield (E + H)	J Amount of sugar used (g/l)	K Average % S consumed	L Yield g X / g S	M Yield (fm curve) g X / g S	N % of actual Yield
$t_0 - t_1$	0.0416652	1.4458102	5.48	1.4925	0.263833977	0.258098264	97.83%
$t_1 - t_2$	0.024354261	2.45201186	19.17	8.206	0.127908809	0.144275124	112.80%
$t_2 - t_3$	0.007329792	1.152609792	10.95	16.409	0.105261168	0.097997972	93.10%
$t_3 - t_4$	0.103634643	2.7876522	52.025	33.56	0.053582936	0.05021553	93.72%

Table 3

}

Revised table and graph

A Interval	B Observed New X	C Total hours of interval	D Mass lost from starting X decay
$t_0 - t_1$	1.315	15.75	0.089145
$t_1 - t_2$	2.37	5.28	0.0576576
$t_2 - t_3$	1.08	3.2	0.06528
$t_3 - t_4$	2.2	19.58	0.4840176

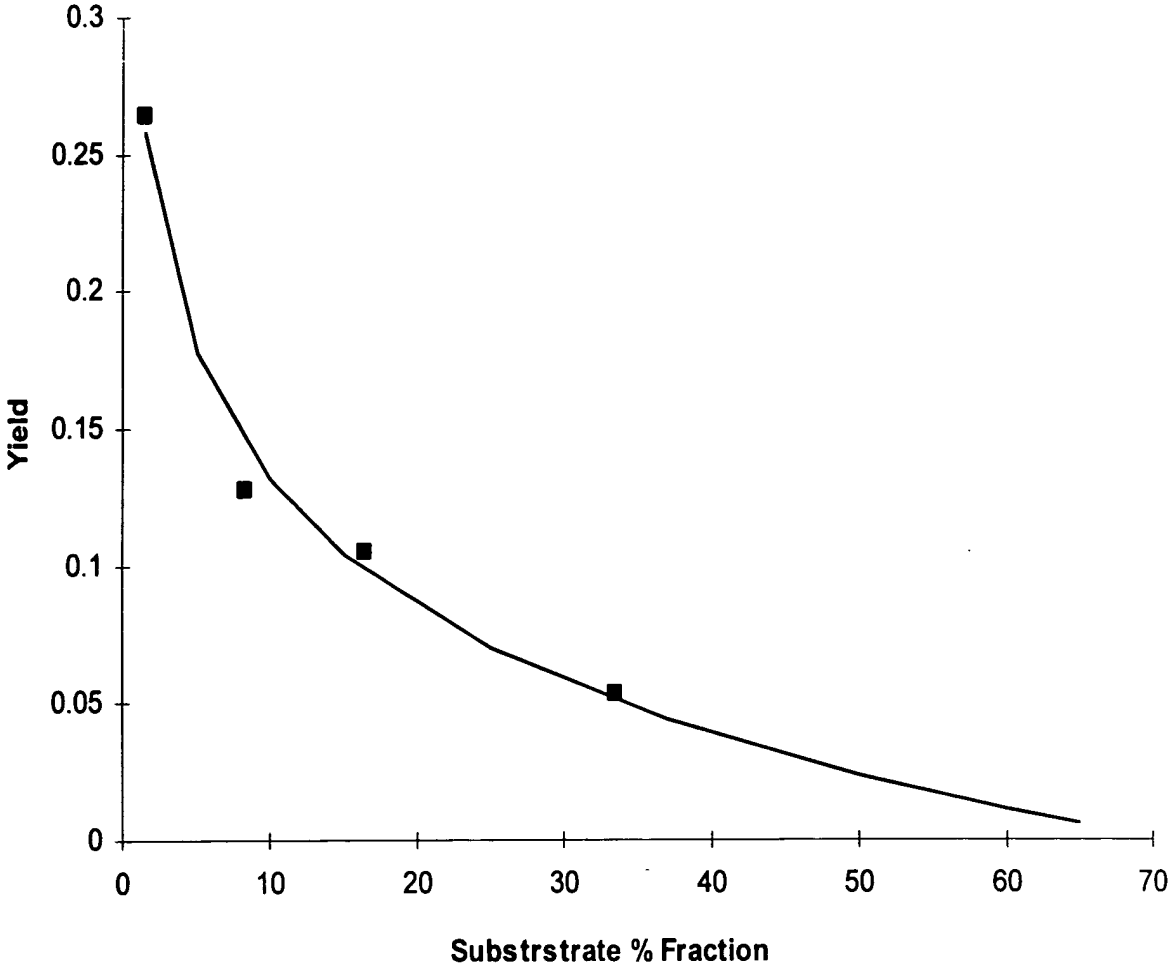
A Interval	E Sub-total new mass (B + D)	F Ratio new X/Start X (Starting X + E) / Starting X	G Charge what new mass b? (EQXchrgd)
$t_0 - t_1$	1.404145	1.9923	0.471
$t_1 - t_2$	2.4276576	1.88925	0.475
$t_2 - t_3$	1.14528	1.22457	0.5
$t_3 - t_4$	2.6840176	1.434307	0.493

A Interval	H Decay of new mass (E x G x C x .004)	I Total new mass yield (E + H)	Amount of sugar used (g/l)
$t_0 - t_1$	0.0416652	1.4458102	5.48
$t_1 - t_2$	0.024354261	2.45201186	19.17
$t_2 - t_3$	0.007329792	1.152609792	10.95
$t_3 - t_4$	0.103634643	2.7876522	52.025

A Interval	J Average % S consumed	K Yield g X / g S	L Yield (fm curve) g X / g S
$t_0 - t_1$	1.4925	0.263833977	0.258098264
$t_1 - t_2$	8.206	0.127908809	0.144275124
$t_2 - t_3$	16.409	0.105261168	0.097997972
$t_3 - t_4$	33.56	0.053582936	0.05021553

A Interval	M % of actual Yield
$t_0 - t_1$	97.83%
$t_1 - t_2$	112.80%
$t_2 - t_3$	93.10%
$t_3 - t_4$	93.72%

FIG.15



$$Y = \left\{-6.678143050038 \times 10^{-2} \times [\ln(\%\text{used})]\right\} + 0.284841059276$$

FIG.16

Table changed to portrait orientation

{

Table 4

Evaluation of Test Fermentation

Interval	% fraction of S	Yield fm EQ%used	Ratio fm EQYld (l CO_2/g X)	Total new X (grams)
$t_0 - t_1$	1.4925	0.2580973	0.79324921	1.445803
$t_1 - t_2$	8.206	0.14427497	1.52663404	2.452006
$t_2 - t_3$	16.409	0.097998	2.3594534	1.1526299
$t_3 - t_4$	33.56	0.0502161	5.00801093	2.787623

Interval	liters CO_2 predicted fm model (g X x Ratio)	liters CO_2 predicted by actual Yield	Average measured CO_2 (ml / min)	liters CO_2 predicted fm avg of measured CO_2 flow rate at this interval
$t_0 - t_1$	1.1469	1.1192	1.972	1.8635
$t_1 - t_2$	3.7433	4.2872	8.144	2.58
$t_2 - t_3$	2.71968	2.5095	13.709	2.6321
$t_3 - t_4$	13.9604	12.9849	11.154	13.1037

}

Revised table

Interval	% fraction of S	Yield fm EQ%used	Ratio fm EQYld (l CO_2/g X)
$t_0 - t_1$	1.4925	0.2580973	0.79324921
$t_1 - t_2$	8.206	0.14427497	1.52663404
$t_2 - t_3$	16.409	0.097998	2.3594534
$t_3 - t_4$	33.56	0.0502161	5.00801093

Interval	Total new X (grams)	liters CO_2 predicted fm model (g X x Ratio)	liters CO_2 predicted by actual Yield
$t_0 - t_1$	1.445803	1.1469	1.1192
$t_1 - t_2$	2.452006	3.7433	4.2872
$t_2 - t_3$	1.1526299	2.71968	2.5095
$t_3 - t_4$	2.787623	13.9604	12.9849

Interval	Average measured CO_2 (ml / min)	liters CO_2 predicted fm avg of measured CO_2 flow rate at this interval
$t_0 - t_1$	1.972	1.8635
$t_1 - t_2$	8.144	2.58
$t_2 - t_3$	13.709	2.6321
$t_3 - t_4$	11.154	13.1037

FIG.17